Cancer in Calcasieu Parish, Louisiana: 1988-1997

LOUISIANA DEPARTMENT OF HEALTH & HOSPITALS
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CANCER IN CALCASIEU PARISH, LOUISIANA: 1988-1997

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EXECUTIVE SUMMARY

- As part of the follow-up to the Mossville Dioxin Exposure Investigation, the Louisiana Department of Health & Hospitals has reviewed cancer data for Calcasieu Parish.
- The cancer review compares cancer incidence of Calcasieu Parish and the State of Louisiana for the period 1988-1997. Age-adjusted rates of all cancers combined and cancers of 22 specific anatomic sites were examined for the following demographic groups: black females, white females, black males, and white males.
- The review discerns cancer incidence ratios that are significantly higher or lower than statewide norms. Because risk-factor exposure data are not available for cancer cases, the review cannot determine the cause(s) of significantly elevated/decreased rates.
- Overall cancer incidence for black females, white females, and white males in Calcasieu Parish was comparable to statewide incidence. Overall cancer incidence for black males was significantly lower than the state rate.
- Black females had significantly lower incidence of cervical cancer and multiple myeloma in Calcasieu Parish than statewide. Black females in Calcasieu Parish had significantly higher rates of colorectal cancer, lung cancer, and soft tissue tumors than statewide.
- Site-specific cancer incidence for black males in Calcasieu Parish did not differ significantly from black males statewide.
- White females had significantly lower ovarian cancer incidence in Calcasieu Parish than statewide. White females in Calcasieu Parish had significantly higher incidences of skin cancer, cervical cancer, bladder cancer, soft tissue tumors, and lung cancer.

- White males in Calcasieu Parish had a significantly lower incidence of oral cavity and pharyngeal cancers than statewide. White males in Calcasieu Parish had significantly higher incidences of skin cancer and soft tissue tumors.
- Among site-specific cancers occurring significantly more frequently in Calcasieu Parish, soft tissue tumors and lung cancer show consistency across demographic strata, being elevated in at least two of the four gender-race groups examined. Site-specific cancers occurring significantly less frequently in Calcasieu Parish showed no such consistency, each being limited to a single gender-race stratum.
- Different cancers have different risk factors. The cancers for which rates were elevated in Calcasieu Parish have a variety of risk factors, as listed in Table 24, page 26, of this review. The respective contributions of these risk factors to cancer incidence in Calcasieu Parish cannot be determined by this review.

PURPOSE

As part of the Louisiana Department of Health & Hospitals' ongoing environmental health investigation in Mossville, Louisiana, this report examines cancer incidence data for Calcasieu Parish. It addresses community concerns of increased cancer rates among area residents.

INTRODUCTION

Mossville is a small, unincorporated community in Calcasieu Parish, near Lake Charles. Residents have expressed health and quality of life concerns related to industrial activity in the area. An exposure investigation of blood dioxin levels in 28 Mossville residents, conducted by the Agency for Toxic Substances & Disease Registry (ATSDR) in 1998, detected elevated dioxin levels in some residents.[1] Dioxins are a highly toxic family of chemicals, formed as byproducts of various human activities involving chlorinated organic compounds. They are widely believed to be *carcinogenic* (cancer-causing).[2]

Public concerns about dioxins and other chemical pollutants in the Mossville/Lake Charles area warrant thoughtful public health response. A review of cancer incidence rates is an important component of such a response. The Louisiana Department of Health & Hospitals (LDHH) has conducted this review as the final component of its five-part response plan. Previous LDHH actions have included: a residential needs assessment of the Mossville community; creation of a residential steering group; facilitating enrollment of area residents into Medicare, Medicaid, and the Louisiana Children's Health Insurance Program; and educating local physicians on the health effects of dioxins.

METHODS

Cancer *incidence* is the number of new cancer cases diagnosed over a period of time. This report reviews cancer incidence in Calcasieu Parish and compares it to the entire State of Louisiana. The Louisiana Department of Health & Hospitals, Office of Public Health (LDHH/OPH) obtained cancer incidence data for the entire state from the Louisiana Tumor Registry (LTR) for the period 1988-1997. Using SAS statistical analysis software, cancer cases occurring in Calcasieu Parish from 1988 to 1997 were derived from the statewide database.[3] Statistical comparisons of Calcasieu Parish versus statewide cancer incidence were made for twenty-two distinct types of cancer and all cancers combined. Specific cancers examined included: bladder, brain, breast, cervical, colorectal, esophageal, leukemia, liver, lung, lymphomas, multiple myeloma, oral, ovarian, pancreatic, prostate, renal (kidney), soft tissue tumors, skin, stomach, testicular, thyroid, and uterine. Because cancer rates vary by race and sex, separate comparisons for each of these anatomic sites were made for black females, black males, white females, and white males.

Statistical comparisons of cancer incidence between Calcasieu Parish and Louisiana used *standardized incidence ratios* (SIRs). The SIR is defined as the *observed* number of cancer cases divided by the *expected* number of cancer cases. The expected number of cases is based on cancer incidence in the comparison population. Because cancer rates increase with age, study and comparison populations must have similar age compositions or be age-adjusted for comparisons to be meaningful. The investigators age-adjusted expected numbers of cancer cases for Calcasieu Parish by multiplying Louisiana's age-specific incidence rates by the parish's age-

specific population data. National Cancer Institute (NCI) annual estimates provided the age-specific populations. Dividing observed numbers of cases by the age-adjusted expected numbers of cases yielded the SIRs (see Figure 1, page 27, for example).

If the observed number of cases equals the expected number of cases, the SIR is 1. When the SIR is less than 1, fewer cases were observed than expected. For SIRs greater than 1, more cases were observed than expected. A chi-square (X^2) test assesses whether SIRs differ significantly from 1. A *statistically significant* difference in cancer incidence occurs when there is a 5- percent-or- less probability that the difference in observed and expected rates could be due to chance alone ($p \leq .05$). *Confidence intervals* (CIs) mark the boundaries of statistical significance. If the confidence interval for an SIR does not encompass 1, the observed number of cases differs significantly from the expected number of cases.

RESULTS

Tables 1 through 23 show the age-adjusted cancer incidence data and SIRs for Calcasieu Parish versus the State of Louisiana from 1988 to 1997. For black females, white females, and white males, SIRs for all cancers combined were neither significantly higher nor lower than expected. Black males in Calcasieu Parish had an overall cancer incidence that was significantly lower than statewide (see Table 1, page 21).

The SIRs for the 22 specific anatomic sites reviewed were, for the most part, within expected limits. Some SIRs, however, were significantly higher or lower than 1. Oral cavity and pharyngeal cancers were significantly lower for white males in Calcasieu Parish, compared to Louisiana. Ovarian cancer was significantly lower among white females in Calcasieu Parish

than statewide. Cervical cancer and multiple myeloma were significantly lower among black females in Calcasieu Parish than the comparison population. Specific sites and demographic groups for which cancer incidence was higher in Calcasieu Parish include: bladder cancer in white females; cervical cancer in white females; colorectal cancer in black females; lung cancer in black females and white females; skin cancer in white females and white males; and soft tissue tumors in black females, white females, and white males.

Table 2, page 21, shows age-adjusted bladder cancer incidence for Calcasieu Parish versus the State of Louisiana, indicating a significantly increased incidence in white females in Calcasieu Parish (SIR = 1.31; CI = 1.05, 1.61).

Table 5, page 21, shows age-adjusted cervical cancer incidence for Calcasieu Parish versus Louisiana, indicating significantly lower incidence for black females in Calcasieu Parish (SIR = 0.67; CI = 0.43, 0.97) and significantly higher incidence among white females in Calcasieu Parish (SIR = 1.42; CI = 1.13, 1.74), compared to the state.

Table 6, page 22, gives age-adjusted colorectal cancer incidences for Calcasieu Parish and the State of Louisiana, showing a significantly elevated incidence among black females in Calcasieu Parish (SIR = 1.32; CI = 1.08, 1.58).

Table 10, page 23, lists age-adjusted lung cancer incidence for Calcasieu Parish and Louisiana, with significantly elevated incidence for black females in Calcasieu Parish (SIR = 1.37; CI = 1.12, 1.65) and white females in Calcasieu Parish (SIR = 1.12; CI = 1.01, 1.22).

Table 12, page 23, gives age-adjusted multiple myeloma incidence for Calcasieu Parish and Louisiana, showing a significantly lower incidence for black females in Calcasieu Parish (SIR = 0.45; CI = 0.16, 0.88).

Table 13, page 23, displays the standardized incidence ratio for oral cavity and pharyngeal cancers, indicating significantly lower incidence for white males in Calcasieu Parish, compared to the state (SIR = 0.78; CI = 0.62, 0.96).

Table 14, page 23, lists age-adjusted ovarian cancer incidence for Calcasieu Parish and Louisiana. Ovarian cancer incidence was significantly lower for white females in Calcasieu Parish than the state (SIR = 0.71; CI = 0.55, 0.89).

Table 18, page 24, provides age-adjusted skin cancer data for Calcasieu Parish versus the state, indicating significantly elevated incidence for white females (SIR = 1.65; CI = 1.34, 1.99) and white males (SIR = 1.38; CI = 1.16, 1.63) in Calcasieu Parish.

Table 19, page 25, displays age-adjusted incidence for soft tissue tumors, showing significantly elevated incidence among black females (SIR = 2.22; CI = 1.06, 3.81), white females (SIR = 1.93; CI = 1.27, 2.72), and white males (SIR = 1.64; CI = 1.11, 2.28) in Calcasieu Parish, relative to Louisiana. Soft tissue tumor incidence for black males could not be presented due to the small number of cases.[4]

DISCUSSION

I. Background

Cancers are diseases of uncontrolled growth and multiplication of cells in the body. There are many different types of cancer, classified by where in the body they originate. The various cancers have different risk factors, treatments, and survival rates.

Despite these differences, there are aspects common to the development of all cancers. Cancers are *monoclonal*; that is, they arise from a single transformed cell. The process of

transformation involves multiple steps, *initiation* and *promotion*.[5] Initiation occurs with a mutation of a cell's genetic material (DNA). Promotion then follows, inducing the mutated cell to multiply. A long time usually intervenes between these two steps, a latency period of 10 to 30 years from initiation to development of cancer.[6]

Cancers have both genetic (inherited) and environmental risk factors. Some individuals have genes that predispose them to cancer, irrespective of environmental influences. Genetic factors alone, however, account for a minority of cancers, an estimated 5 to 10 percent.[7] Environmental factors, including radiation, chemicals, and infectious agents, acting in concert with genetic factors, cause the majority of cancers. The sources of environmental exposures are various: diet, smoking, sunlight, household chemicals, alcohol, reproductive behaviors, pollution, etc. The roles of these respective risk factors differ depending on the type of cancer. Excessive exposure to sunlight, for example, is the primary cause of skin cancer, but does not cause cancer at other sites.

Cancer rates vary with age, gender, and race. Data must therefore be controlled for these variables if comparisons are to be meaningful. Older individuals generally have higher cancer incidence rates. Women have higher rates of some cancers (e.g., thyroid and breast), whereas men have higher rates of others (e.g., colon and bladder). African-Americans have higher rates of multiple myeloma, whereas Caucasians have higher rates of lymphomas. For all sites combined in Louisiana, black males have the highest cancer incidence, followed (in decreasing order) by white males, white females, and black females (see Figure 2, page 28).[8]

Significant differences in incidence between Calcasieu Parish and the State of Louisiana were found for several cancers and demographic subgroups. The choice of Louisiana as a

comparison population may have influenced these results. Numbers of expected cancer cases for Calcasieu Parish were based on statewide rates. Different comparison populations might have generated different results. The investigators chose Louisiana cancer rates to compute expected incidence because they provide large, stable rates from a population geographically and demographically similar to Calcasieu Parish. After calculating SIRs with the State of Louisiana as a comparison population, the SIRs were computed again, using southern Louisiana as the comparison population. The results were consistent. For cancers with significantly elevated rates in more than one gender-race stratum in Calcasieu Parish, SIRs were additionally recalculated using NCI Surveillance, Epidemiology, and End Results (SEER) rates. Compared to the nationwide SEER data, skin cancer rates among white males and white females in Calcasieu Parish were no longer significantly elevated. This was the only change in statistical significance resulting from use of the nationwide comparison population.

Discussion of risk factors for cancers with significant differences in incidence between Calcasieu Parish and the State of Louisiana follows.

II. Sites with Lower Rates

White males in Calcasieu Parish had a significantly lower-than-expected incidence of oral cavity and pharyngeal cancers. Risk factors for oral and pharyngeal cancers include tobacco and alcohol abuse and poor oral hygiene. There is a synergy between alcohol and tobacco use.[9] Avoidance of these risk factors would be expected to lessen oral cavity and pharyngeal cancer incidence.

Black females in Calcasieu Parish had a significantly lower-than-expected incidence of

cervical cancer. Risk factors for cervical cancer include human papilloma viruses and, to a lesser extent, cigarette smoking. Barrier contraception, sexual abstinence, and early detection of precancerous lesions by Pap smears are protective.[10] The Office of Public Health targeted an intervention in Calcasieu Parish Public Health Units after identifying high cervical cancer rates in the parish in the 1980s. It appears to have succeeded among African-American women.

Black females in Calcasieu Parish had a significantly lower incidence of multiple myeloma. Risk factors for multiple myeloma are poorly understood, but are thought to include family history, radiation and chemical exposures.[11]

White females in Calcasieu Parish had a significantly lower incidence of ovarian cancer than expected. Risk factors for ovarian cancer include nulliparity (childlessness) and family history.[12]

III. Sites with Higher Rates

Table 24, page 26, summarizes established risk factors for cancers with elevated rates in Calcasieu Parish. Black females and white females in Calcasieu Parish both had significantly higher lung cancer incidence than expected. Cigarette smoking is the primary risk factor for lung cancer in the United States.[13] Other documented risk factors include radiation, asbestos, bis-chloromethyl ether, chloromethyl methyl ether, beryllium, mustard "gas", and metal fumes (nickel, arsenic, chromium, lead).[14] Some studies also associate dioxin exposure with lung cancer.[15] These risk factors are not mutually exclusive. In fact, exposure to multiple carcinogens can have synergistic effects, whereby the combined risk is greater than the sum of the individual risks. The risk of lung cancer in smokers with a history of asbestos exposure, for

example, is 10 times that of non-smoking asbestos workers and 5 times that of smokers without a history of asbestos exposure.[16]

Given available estimates of tobacco use in Calcasieu Parish, cigarette smoking does not seem to account for the elevated lung cancer incidence among females. The reported smoking rate in the parish (26%) matches that of the state.[17] This estimate, however, does not provide gender-specific data, cigarettes per day, or years of tobacco use. Furthermore, the latency between exposure and the development of lung cancer limits the relevance of current tobacco use to current lung cancer incidence.

White females in Calcasieu Parish had significantly higher bladder cancer incidence than expected. Risk factors for bladder cancer include smoking, analgesic abuse, and exposure to such synthetic chemicals as azo dyes, 4-aminobiphenyl, 4-nitrobiphenyl, benzidine, alpha-naphthylamine, and beta-naphthylamine.[18]

White females in Calcasieu Parish also had a significantly higher elevated incidence of cervical cancer. Risk factors for cervical cancer include human papilloma viruses and, to a lesser extent, cigarette smoking. Barrier contraception, sexual abstinence, and early detection of precancerous and *in situ* lesions by Pap smears are protective.

Black females in Calcasieu Parish had a significantly elevated colorectal cancer incidence. Risk factors for colorectal cancer are dietary, particularly diets low in fresh fruits and vegetables and high in fats and refined sugars.[19] Studies also suggest that routine use of anti-inflammatory agents such as aspirin can reduce the risk of colorectal cancer.[20]

White females and white males in Calcasieu Parish had significantly elevated skin cancer incidence. Skin cancer data do not include basal cell or squamous cell carcinomas, and consist

mainly of melanoma cases. Ultraviolet exposure from sunlight is the primary risk factor for skin cancer.[21] People who work outdoors are at an increased risk, as are people with multiple sunburns. Caucasians are at much higher risk of skin cancer than African-Americans because of their relative lack of pigmentation. Chronic dermal exposure to chemicals such as arsenic, creosote, tars, and certain mineral oils is also associated with skin cancer.[22]

Black females, white females, and white males in Calcasieu Parish had significantly elevated incidence of soft tissue tumors. Risk factors for soft tissue tumors include agricultural employment, genetic factors, and possibly exposure to dioxins and herbicides.[23]

IV. Multiple Comparisons and Statistical Significance

This review compares Calcasieu Parish versus Louisiana cancer incidence ratios at 22 anatomic sites and for all sites combined. For each type of cancer, two to four demographic subgroups were compared for a total of 82 comparisons. When making so many comparisons, the likelihood that a statistically significant difference will appear by chance increases. A result is considered statistically significant when it has a 1-in-20-or-fewer chance of occurring randomly. This equals a probability of five percent or less (written " $p \leq .05$"). For example, the chances of flipping a coin "heads" five times in a row are 1-in-32. A run of five heads is significantly non-random, and should make you wonder whether the coin is fair. Tossing a coin 100 times, however, the chances of a run of five consecutive "heads" are twenty times greater than when tossing the coin only five times: 20-in-32 or 62.5%. So, a run of five heads in a 100-toss trial is more likely due to chance than the coin being unfair. Likewise, with 82 cancer incidence comparisons, using a significance level of $p \leq .05$, one would expect to find 4

statistically significant differences by chance alone.[24]

This review found 15 statistically significant differences in cancer incidence between Calcasieu Parish and the State of Louisiana. Fourteen of these significant cancer incidence differences were for specific anatomic sites. This is more than would be predicted by chance alone at the $p \leq .05$ significance level. Furthermore, several of the SIRs are significant at much lower p-values. The SIR for soft tissue tumors in black females, for example, has a less than one percent probability of arising by chance. Ten site-specific comparisons revealed significantly higher cancer incidence in Calcasieu Parish, whereas four site-specific comparisons showed significantly lower incidence. Significantly elevated incidence at specific anatomic sites was found primarily among females. Black males in Calcasieu Parish had a lower overall cancer incidence compared to the state, although incidence at the specific anatomic sites examined was similar to its statewide counterparts. The above analysis suggests that most of the significant cancer incidence differences between Calcasieu Parish and the State of Louisiana are not due to chance. Confidence that a significant difference in cancer incidence is not due to chance increases when it is consistent across demographic subgroups, though this is not a necessary criterion. The SIRs for soft tissue tumors, for example, are significantly elevated among black females, white females, and white males in Calcasieu Parish relative to Louisiana. Likewise, lung cancer incidence is significantly higher for both black females and white females in Calcasieu Parish, compared to the state. Skin cancer incidence shows a similar consistency, significantly elevated among white females and white males in Calcasieu Parish (though not elevated in comparison to nationwide SEER rates). Conversely, significant differences in incidence for ovarian cancer, cervical cancer, bladder cancer, colorectal cancer, oral cavity and

pharyngeal cancer, and multiple myeloma are limited to one demographic subgroup, and are less compelling.

Identifying elevated incidence of certain cancers among various gender/racial groups in Calcasieu Parish is valuable and informative, but, in the absence of exposure data, gives no indication as to the cause. The investigators have listed risk factors for these malignancies but cannot be sure which of them (or what combination of them) is responsible. The presence of a risk factor in an area with elevated cancer incidence suggests, but does not prove, a causal association. For example, a number of chemical carcinogens are manufactured or formed as byproducts at industrial facilities in Calcasieu Parish. The degree of exposure of the local public to such substances is unknown, however, and the subject of ongoing inquiry. A causal inference would require that cancer cases have a higher degree of exposure than non-cases. Because tumor registry data lack information about exposure to chemicals or any other cancer risk factors, this review does not allow such correlations.

V. Dioxins and Cancer

This review of cancer incidence in Calcasieu Parish for the period 1988 to 1997 resulted from the finding of elevated blood dioxin levels in some Mossville residents. There is considerable evidence that some polychlorinated dibenzo-*para*-dioxins (PCDDs) are carcinogenic (cancer-causing). Although data are equivocal in some respects, support for the idea that dioxins promote cancer continues to mount. The International Agency for Research on Cancer (IARC) declares 2,3,7,8-tetracholorodibenzo-p-dioxin (TCDD) a human carcinogen based on “limited evidence” from epidemiologic studies and “sufficient evidence” from animal

experiments.[25] Other dioxins, according to IARC, are "not classifiable as to their carcinogenicity in humans."[26]

In epidemiologic studies, dioxin exposure has been associated with increased mortality from cancer at all sites combined, lung cancer, lymphomas, soft tissue sarcomas and multiple myelomas.[27] Many studies linking dioxins with cancer are compromised by poor exposure information and concurrent exposures. Very few epidemiologic studies of dioxins' carcinogenicity have assessed dioxin exposure with biological monitoring. Many studies have used occupation as a proxy for estimating dioxin exposure. Cancer rates for individuals in occupations with a tendency toward dioxin exposure (e.g., herbicide manufacturers, mixers, and applicators) are compared to those of individuals in occupations tending toward minimal dioxin exposure.[28] Frequent concurrent exposures to other hazardous chemicals among individuals in high-dioxin occupations make it hard to attribute excess cancers to any particular chemical. Studies of agricultural workers, for example, which have found elevated rates of lymphomas and soft tissue sarcomas, may be confounded by exposure to scores of other agricultural chemicals, including pesticides with established carcinogenic effects. Variability of dioxin exposure among individuals in the same occupation further complicates studies of the relationship between dioxins and cancer.

Accurate exposure assessment is vitally important to determine the dose-response characteristics for dioxins and cancer. Although some dioxins appear to be carcinogenic at high doses, there may be a threshold below which they are not harmful.[29] Some recent epidemiologic studies of dioxin and cancer have assessed dioxin exposure directly by blood testing. Often, they have shown little correlation between blood dioxin levels and exposure estimation by other

means.[30]

Dioxins' ability to cause cancer in laboratory animals has been more clearly demonstrated. The experimental setting allows precise correlation of dose and response. In mice, 2,3,7,8-TCDD has been associated with benign and malignant liver and lung tumors, lymphomas, sarcomas, and benign thyroid tumors.[31] In rats, 2,3,7,8-TCDD is associated with benign and malignant liver tumors, skin, oral and lung cancers, and benign thyroid tumors.[32] Laboratory animal evidence for carcinogenicity of other dioxins is uncertain. Penta- and heptachlorodibenzo-*p*-dioxins have been shown to cause pathologic changes in the livers of experimental animals.[33]

The results of the Calcasieu Parish cancer incidence review are provocative in that they show statistically significant elevations of two cancers for which dioxin exposure is a risk factor. Lung cancer rates for the period 1988-1997 were significantly increased among black females and white females in Calcasieu Parish. Soft tissue tumor rates over the same period were significantly elevated for black females and white males in Calcasieu Parish.

Despite these findings, this review cannot link excess cancer incidence in Calcasieu Parish to dioxins or any other risk factor. The main reason for this is the lack of exposure information for Calcasieu Parish cancer cases. The Mossville Dioxin Exposure Investigation, for example, measured blood dioxin levels from 28 Mossville residents, approximately half of whom had dioxin levels that were considered elevated. With narrow exceptions, LDHH does not have access to these individuals' identities nor their cancer histories. For the Mossville blood dioxin data to pertain to cancer incidence in the parish, they would have to be representative of blood dioxin levels across the parish. There is not yet sufficient evidence that this is the case. In fact,

the Agency for Toxic Substances & Disease Registry focused its exposure investigation on Mossville because it suspected that Mossville would have the highest blood dioxin levels in the Calcasieu Parish area.[34] Conversely, LDHH mapped Calcasieu Parish cancer cases by street address, and found no cases soft tissue tumors who lived in Mossville at the time of diagnosis.[35] Wider sampling of blood dioxin levels in Calcasieu Parish is warranted to assess the extent of dioxin exposure in the region and its possible relationship to cancer incidence there.

CONCLUSION

Overall cancer incidence in Calcasieu Parish from 1988 to 1997 did not differ significantly from the State of Louisiana for black females, white females, and white males. Black males in Calcasieu Parish had significantly lower overall cancer incidence than in the state. Specific anatomic sites and demographic groups in Calcasieu Parish for which cancer rates were significantly lower than the state during this period included: cervical cancer and multiple myeloma in black females; ovarian cancer in white females; and oral cavity and pharyngeal cancer in white males. Specific anatomic sites and demographic groups in Calcasieu Parish for which cancer incidence was elevated included: cervical cancer among white females; colorectal cancer among black females; bladder cancer among white females; lung cancer among black females and white females; skin cancer among white females and white males; and soft tissue tumors among black females, white females, and white males. Among cancers with elevated incidence, bladder cancer, lung cancer, skin cancer, and soft tissue tumors have risk factors that include chemical exposures. Several epidemiologic studies have associated lung cancer and soft tissue tumors with dioxin exposure. The role of these risk factors in excess cancer cases in

Calcasieu Parish is unknown, but warrants further inquiry.

RECOMMENDATIONS

1. The Agency for Toxic Substances & Disease Registry (ATSDR) should conduct additional blood dioxin sampling throughout Calcasieu Parish and an appropriate Louisiana comparison population.
2. Individuals with elevated blood dioxin levels should be included in ATSDR's National Exposure Registry, Dioxin Subregistry.
3. Ambient environmental monitoring for dioxins and other contaminants of concern by the Louisiana Department of Environmental Quality and the United States Environmental Protection Agency should continue.
4. The Louisiana Department of Health & Hospitals should convene a panel of environmental and health experts to determine other appropriate public health responses to the findings of this review.

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[2] U. S. Department of Health & Human Services. Toxicological Profile for Chlorinated Dibenzo-p-Dioxins (Update). Research Triangle Institute, 1998.

[3] The Louisiana Tumor Registry (LTR) updates the statewide database as new case reports arrive. There is a tendency for the number of cases reported for a given time period to increase slightly, the more time passes after that period. Data used in this review were provided by LTR in 1999.

[4] LTR guidelines require withholding of data when there are five or fewer cases for reasons of individual privacy and confidentiality.

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[6] Levy BS & Wegman DH. Occupational Health: Recognizing and Preventing Work-Related Disease (3rd ed.). Little, Brown & Co., Boston, 1995, p. 293.

[7] Cotran et al., p. 268.

[8] Correa C, Cheng W X, Andrews P, Ahmed M, Schmidt B & Chen V. Cancer Incidence and Mortality in Louisiana: 1992-1996. Louisiana Tumor Registry, New Orleans, 2000.

[9] Cotran et al., p. 265.

[10] Cotran et al., p. 1142.

[11] Cotran et al., p. 740.

[12] Cotran et al., p. 1158.

[13] Cotran et al., p. 797.

[14] Cotran et al., p. 798.

[15] International Agency for Research on Cancer, pp. 336, 337.

[16] Cotran et al., p. 480.

[17] Louisiana Department of Health & Hospitals, Office of Public Health. Calcasieu Parish Health Profile 1999 (in press).

[18] Cotran et al., p. 1091. Levy & Wegman, p. 291.

[19] Cotran et al., p. 898.

[20] Arber N. Do NSAIDs prevent colorectal cancer? Canadian J Gastroenterol, 2000, 14 (4): 299-307.

[21] Cotran et al., p. 1282.

[22] Levy & Wegman, pp. 291, 500.

[23] Zahn S & Fraumeni J. The epidemiology of soft tissue sarcoma. Semin Oncol, 1997, 24 (5): 504-514.

[24] A *type I error* occurs when the investigator mistakenly concludes that there is a statistically significant difference between two populations. Concluding the coin is not fair, when, in fact, it is, would be a type I error. Concluding the coin is fair when, in fact, it is not, would be a *type II error.* Making multiple comparisons increases the chances of type I error.

[25] International Agency for Research on Cancer, p. 342.

[26] Ibid., p. 343.

[27] Ibid., pp. 336-338.

[28] Fingerhut M, Halperin W, Marlow D, Piacetelli L, Sweeney M, Griefe A, Steenland K & Suruda A. Cancer mortality in workers exposed to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin. New Engl J Med, 1991, 324: 212-218. International Agency for Research on Cancer, pp. 138-161.

[29] Teegurden et al. Quantitative analysis of dose- and time-dependent promotion of four phenotypes of altered hepatic foci by 2,3,7,8-tetrachlorodibenzo-*p*-dioxin in female Sprague-Dawley rats. Toxicological Sciences, 1999, 51 (2): 221- 223.

[30] International Agency for Research on Cancer, p. 165.

[31] Ibid., p. 338.

[32] Ibid.

[33] Ibid.

[34] Agency for Toxic Substances & Disease Registry. Mossville Exposure Investigation Report.

[35] This finding is limited to the period reviewed (1988-1997) and by the accuracy of the investigators' geocoding methodology. Residential histories prior to diagnosis were not available. Cases might have lived in Mossville at an earlier date. The investigators did discern a number of lung cancer cases who lived in Mossville at the time of diagnosis.

[36] all sites per 100,000 persons per year

Appendix 1: Tables 1-24

TABLE 1: CANCER INCIDENCE AT ALL SITES

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	631	611.4	1.03	0.95	1.11
	male	741	800.3	***0.93***	***0.86***	***0.99***
White	female	2704	2650.5	1.02	0.98	1.06
	male	3098	3128.7	0.99	0.96	1.03

TABLE 2: BLADDER CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	7	8.7	0.80	0.32	1.51
	male	26	20.9	1.24	0.81	1.77
White	female	84	64.1	***1.31***	***1.05***	***1.61***
	male	202	194.5	1.04	0.90	1.19

TABLE 3: BRAIN AND NERVOUS SYSTEM CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	7	6.90	1.01	0.40	1.91
	male	8	6.70	1.19	0.51	2.16
White	female	29	37.90	0.77	0.51	1.07
	male	41	44.20	0.93	0.67	1.23

TABLE 4: BREAST CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	159	175.2	0.91	0.77	1.05
White	female	755	795.6	0.95	0.88	1.02

TABLE 5: CERVICAL CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	24	35.8	***0.67***	***0.43***	***0.97***
White	female	84	59.2	***1.42***	***1.13***	***1.74***

TABLE 6: COLORECTAL CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	104	78.9	***1.32***	***1.08***	***1.58***
	male	80	78.1	1.02	0.81	1.26
White	female	329	332.5	0.99	0.89	1.10
	male	371	352.6	1.05	0.95	1.16

TABLE 7: ESOPHAGEAL CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	9	6.6	1.36	0.62	2.40
	male	26	21.7	1.20	0.78	1.70
White	female	13	14.4	0.90	0.48	1.46
	male	37	38.6	0.96	0.67	1.29

TABLE 8: LEUKEMIA INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	16	11.4	1.40	0.80	2.18
	male	11	15.7	0.70	0.35	1.18
White	female	63	63.1	1.00	0.77	1.26
	male	66	79.1	0.83	0.65	1.05

TABLE 9: LIVER CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	**	**	**	**	**
	male	12	8.2	1.46	0.75	2.41
White	female	10	12.2	0.82	0.39	1.41
	male	27	28.5	0.95	0.62	1.34

TABLE 10: LUNG CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	104	75.8	***1.37***	***1.12***	***1.65***
	male	172	191.5	0.90	0.77	1.04
White	female	427	382.5	***1.12***	***1.01***	***1.22***
	male	659	671.4	0.98	0.91	1.06

TABLE 11: LYMPHOMA INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	22	18.20	1.21	0.76	1.77
	male	23	21.90	1.05	0.66	1.52
White	female	139	124.10	1.12	0.94	1.31
	male	136	133.80	1.02	0.85	1.19

TABLE 12: MULTIPLE MYELOMA INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	6	13.4	***0.45***	***0.16***	***0.88***
	male	12	15.7	0.76	0.39	1.26
White	female	28	27.9	1.00	0.67	1.41
	male	34	30.5	1.11	0.77	1.52

TABLE 13: ORAL CAVITY AND PHARYNGEAL CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	12	9.5	1.26	0.65	2.08
	male	28	27.9	1.00	0.67	1.41
White	female	42	46.7	0.90	0.65	1.19
	male	83	106.6	***0.78***	***0.62***	***0.96***

TABLE 14: OVARIAN CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	11	17.3	0.64	0.32	1.07
White	female	67	94.2	***0.71***	***0.55***	***0.89***

TABLE 15: PANCREATIC CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	20	23.5	0.85	0.52	1.26
	male	21	22.9	0.92	0.57	1.35
White	female	60	72.3	0.83	0.63	1.05
	male	66	75.2	0.88	0.68	1.10

TABLE 16: PROSTATE CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	male	217	235.2	0.92	0.80	1.05
White	male	810	814.0	1.00	0.93	1.06

TABLE 17: RENAL CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	10	14.4	0.69	0.33	1.19
	male	14	19.8	0.71	0.39	1.13
White	female	70	64.6	1.08	0.84	1.35
	male	82	94.3	0.87	0.69	1.07

TABLE 18: SKIN CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	**	**	**	**	**
	male	**	**	**	**	**
White	female	98	59.5	***1.65***	***1.34***	***1.99***
	male	134	96.8	***1.38***	***1.16***	***1.63***

TABLE 19: SOFT TISSUE TUMOR INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	10	4.5	***2.22***	***1.06***	***3.81***
	male	**	**	**	**	**
White	female	27	14.0	***1.93***	***1.27***	***2.72***
	male	30	18.3	***1.64***	***1.11***	***2.28***

TABLE 20: STOMACH CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	16	17.1	0.94	0.53	1.45
	male	32	29.4	1.09	0.74	1.50
White	female	34	31.1	1.09	0.76	1.49
	male	40	51.6	0.78	0.55	1.03

TABLE 21: TESTICULAR CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	male	**	**	**	**	**
White	male	38	32.2	1.18	0.83	1.59

TABLE 22: THYROID CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	14	8.4	1.67	0.91	2.65
	male	**	**	**	**	**
White	female	48	38.5	1.25	0.92	1.62
	male	15	17.2	0.87	0.49	1.37

TABLE 23: UTERINE CANCER INCIDENCE

		Cases	Cases		95% CI	
Race	**Sex**	**Observed**	**Expected**	**SIR**	**Lower**	**Upper**
Black	female	28	28.4	0.99	0.65	1.38
White	female	117	113.1	1.03	0.86	1.23

TABLE 24: RISK FACTORS FOR CANCER SITES WITH ELEVATED RATES‡

SITE	RISK FACTORS
Bladder	4-aminobiphenyl 4-nitrobiphenyl Analgesic abuse Azo dyes Benzidine Naphthylamines Smoking
Cervix	Human Papilloma Virus infection Maternal use of diethystilbestrol Smoking
Colon and Rectum	Diet Familial polyposis Ulcerative colitis
Lung	Asbestos Beryllium Chloromethyl ethers Dioxin Fossil fuel combustion by products Ionizing radiation Metal fumes (nickel, arsenic, chromium, lead) Mustard gas Smoking, second hand tobacco smoke
Skin	Arsenic Creosote Fair skin Ionizing radiation Mineral oils Tars Ultra-violet radiation Xeroderma pigmentosum
Soft Tissue Tumors	Dioxin Herbicides Genetic syndromes (Gardner's, Werner's, Li-Fraumeni, phakomatoses, neurofibromatosis) Thorotrast Vinyl chloride

‡Includes established risk factors, listed in alphabetical order; other uncertain/unknown risk factors exist.

Appendix 2: Figures 1 and 2

Figure 1: Calculating Stardardized Incidence Ratios (SIRs)

To compare cancer rates between Calcasieu Parish and Louisiana, a statistic known as the Standardized Incidence Ratio (SIR) was used:

$$SIR = \frac{\text{(number of observed cancer cases)}}{\text{(number of expected cancer cases)}}$$

Number of observed cases = the number of cancer cases diagnosed in Calcasieu Parish from 1988 to 1997

Number of expected cases = the number of cancer cases expected to occur in Calcasieu Parish, based on statewide rates, from 1988 to 1997

Because cancer rates increase with age, and different populations may have different age compositions, Louisiana cancer rates were age-adjusted to allow meaningful comparison to Calcasieu Parish. To age-adjust the number of expected cases, Louisiana cancer rates for specific age ranges (e.g., 0-4 years old, 5-9 years old, 10-14 years old) were multiplied by the Calcasieu Parish population totals for those age ranges, then added. For example:

Age range	Calcasieu Parish (Years)		Statewide Population[35]		Cases Incidence[36] Expected
0-4	16,733	x	14.2	=	2.4
5-9	17,674	x	6.5	=	1.1
10-14	18,037	x	8.1	=	1.5
15-19	16,325	x	9.6	=	1.6
20-24	13,391	x	23.8	=	3.2
25-29	14,733	x	54.8	=	8.1
30-34	16,246	x	95.3	=	15.5
35-39	15,255	x	169.4	=	25.8
40-44	12,581	x	276.0	=	34.7
45-49	9,424	x	400.2	=	37.7
50-54	8,290	x	521.5	=	43.2
55-59	8,174	x	695.6	=	56.9
60-64	7,175	x	914.9	=	65.6
65-69	5,528	x	1,189.9	=	65.8
70-74	4,296	x	1,462.3	=	62.8
75-79	3,321	x	1,597.4	=	53.1
80-84	1,692	x	1,768.0	=	29.9
85 & older	1,419	x	1,992.4	=	+ 28.3
				Total	**537.1**

Figure 2: Cancer Rates, All Sites, 1988-1997